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Long term dismantling of a basaltic volcano (Piton des Neiges, La Réunion hotspot).

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We present a structural investigation of destabilization processes at the Piton des Neiges, the extinct volcano of La Reunion Island. We focus on the Cirque of Cilaos (a large erosional depression south of the volcano summit), where the exposed internal structure of Piton des Neiges is made of pahoehoe lava flows of the shield building stage (unknown thickness) and breccias ($\sim$1 km thick), covered by volcanic products of the differentiated stage ($\sim$1 km thick). The breccias contain only basic elements and consist in debris flows and debris avalanches deposits. Beddings in the debris flows and shear structures in the avalanche deposits indicate a runout in the direction 300°. We suggest that these breccias may represent the upper part of the Cap La Houssaye mass wasting events observed onshore and offshore on the western side of la Réunion (Bachèlery et al., 2003). The breccias display many indicators of brittle deformation, such as faults (normal and strike slip) and intrusions (dykes and sills). Fault data inversion allows to recognize two episodes of deformation. The first, older step of deformation is consistent with a minimum principal stress oriented N120. Intrusions related to this deformation are basic magmas of the shield building stage. The second, later stage of extension oriented N-S crosscuts the N120 deformation with intrusion compositions of the differentiated stage. These results show that the dismantling of Piton des Neiges proceeded in two ways: catastrophic episodic destabilization and slow internal deformation. During the shield-building stage, slow and rapid dismantling was occurring in the 300° direction in the studied area, whereas it evolved toward a N-S slow collapse during the differentiated stage of magmatic activity. This result fully agrees with a recent study carried out within debris avalanches deposits in the cirque of Salazie (north of Piton des Neiges summit) which attests that the northern flank of the Piton des Neiges has also been affected by an extensional deformation oriented N-S, characterized by a similar combination of slow deformations and rapid flank failure (Famin and Michon, 2009). Two directions of flank destabilization consistent with debris avalanche flow directions, can thus be distinguished on the Piton des Neiges volcano by structural investigations: the N120 deformation in Cilaos and the N-S deformation in Salazie. Our structural study also reveals that the stress field within a volcanic edifice is complex and evolves with time throughout the life of a basaltic volcano.